

AIR POLLUTION*

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IN honoring me by its invitation to address this learned gathering, the Health Research Council has set me an extraordinarily difficult task: to say in 15 minutes something coherent and meaningful about pollution of the air in the cities of New York and London, of Great Britain and the United States of America. It is tempting to use this time to speak of the immensely valuable work which is now being done on the comparison of the prevalence of respiratory symptoms among the citizens of New York and London; without it, meaningful studies on the epidemiological aspects of the effects of air pollution could not be undertaken. But this work is well known to you and it has been reported elsewhere with admirable clarity by my good friends Donald Reid and Charles Fletcher. Likewise, the important question of cardio-pulmonary semantics has been studied and reported on by Doctors Meneely, Paul, Dorn and Harrison after their welcome visit to us in 1960. Perhaps it is more appropriate to try to give a short account of the problems which beset those of us in Britain who work to try to display the connections between air pollution and disease.

My work in this field began a mere eleven years ago. Then, with the drama of the Meuse Valley, Donora, and London 1952 to stimulate us, it was easy to deplore, in pious terms, the fouling of the air by any substance in the belief that pollution was never beneficial and could manifestly kill. There followed the Beaver Report, and in 1956 the Clean Air Act became law. Smoke is, albeit slowly, disappearing from the air of Britain but we are left with other pollutants, notably sulfur dioxide, which are much more difficult to abolish and, rightly, we, as physicians, are being asked hard specific questions concerning the levels we regard as tolerable; in turn we will be told the cost of achieving purity. There is

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now no room for pious platitudes; just as motor accidents can be prevented by removing the wheels from all vehicles, so pollution can be prevented by forbidding combustion. Thus pragmatism must obviously be preferred to idealism and dogma, but this choice imposes on us the need for rigorous appraisal and self-criticism. We must be clear about the lengths to which we are prepared to go to protect what part of the population and, since concentrations of pollutants vary with time sometimes by as much as two orders of magnitude, we must try to decide what measures are justified to avoid rare gross exacerbations.

Pollution in Britain is due overwhelmingly to the combustion, complete and incomplete, of coal and oil, much of which contains compounds of sulfur as impurities. The commonest pollutant, carbon dioxide, is accepted as innocuous; smoke (from incomplete combustion) and sulfur dioxide are measured routinely and are used as indices of pollution. These two pollutants vary widely in concentration and are present in roughly the same amounts in New York and London. Pollution by motor vehicles constitutes a local hazard (we have found 360 ppm carbon monoxide on the pavement at Oxford Circus), but the topography and climate of neither city favor the formation to any significant extent of the photochemical haze which plagues the citizens of Los Angeles. Vehicle exhaust pollution has been studied very carefully in Britain. Sulfur dioxide is an accepted irritant and coal smoke is rich in carcinogenic substances.

It would seem but a short and safe step from these observations to the allegation that sulfur dioxide causes bronchitis and smoke is responsible for lung cancer. But all we can say with any degree of certainty (and this after much hard work) is that high concentrations of urban pollution, measured in terms of SO_2 and smoke, aggravate existing chronic nonspecific pulmonary disease and, indeed, prove to be an intolerable stress to those in the community who are aged or suffering from severe illness. Much experimental work has been done on both sides of the Atlantic without indicting any single pollutant as the irritant responsible for the manifest effects of "acute" or "sub-acute" pollution. Rather it is thought that a combination of particles and SO_2 might be responsible but mixtures consistently effective in realistic concentrations have not yet been brewed in any laboratory; they are undoubtedly complex and indeed we have no right, on contemplation of the painstaking work of our predecessors in the search,

to expect them to be simple. The search goes on but in the meantime we hope that a wholly welcome natural experiment might provide the answer to the question of the relative importance of the roles of particles and gases; in the past ten years studies of variations in morbidity and mortality have shown them to be closely related to variations in concentrations of smoke and SO_2 ; the implementation of the Clean Air Act has already radically altered the smoke/ SO_2 ratio and it is hoped that it will now be possible to distinguish between the effects of these two main pollutants. The air of New York City, whilst containing similar amounts of suspended matter, is poorer in coal smoke than is the air over London; the application of similar techniques to the study of daily variations in morbidity or mortality which are now starting may well confirm, and will certainly supplement, the results we are hoping to get. Naturally we hope that the abolition of smoke will leave the sulfur dioxide as relatively innocuous as experimental work with low concentrations of the pure gas suggests. Already it has been noted that the mortality associated with episodes of high pollution has been less than formerly, but it is of utmost importance in this context to beware of premature optimism: the susceptibility of a large population must vary greatly as epidemics of infections both remove "susceptibles" and create more by producing convalescent patients; our series of observations is relatively short and the base line moves about to an inconvenient extent. In experimental work in the laboratory paradoxical findings are still bewilderingly common; subjects sensitive to small concentrations of SO_2 are often unaffected by peaks in pollution which may yet affect colleagues who are unmoved by experimental inhalations of much higher concentrations of irritants found in the ambient air.

Air pollution is, of course, still suspect as an etiological factor in the production of chronic bronchitis but it will be hard to indict it with certainty since it is but one of many noxious factors in urban life. Without doubt one of the most powerful irritants applied to the bronchial mucosa is cigarette smoke in comparison with which the everyday concentrations of any pollutant must seem relatively bland.

The presence of "classic" carcinogens in town air (coal smoke is a vastly richer source than that from any vehicles) leads the unwary to believe that they cause cancer. They may well do but they cannot of themselves be responsible for the terrifying rise in the prevalence of the disease which we have been witnessing, since their concentration

in the air has been steadily declining as the disease has rapidly become more common. Much of the epidemiological work which was thought to be impeccable contains results which can now be shown to be artifacts due to alterations in population structure or the differential spread of social habits from town to country. Of course, we know the main answer—the cigarette has been unequivocally indicted in classical reports from both our countries. It remains to display the mechanism whereby it produces its deadly effects and to see in what way pollution of the ambient air is involved. Our work leads us to believe that “classic” carcinogens such as 3:4 benzpyrene may have claimed too much attention in recent years to the detriment of the search for more sophisticated mechanisms by which lung cancer may develop. The manner in which asbestos produces neoplasms, discussed so recently in New York and the subject of intensive work in Great Britain, may have much to teach us with respect to the wider problems of carcinogenesis.

A few years ago it was thought that widespread prospective surveys would in time tell us the answer to the problems of the effects of air pollution on man. They may yet, but changes in pollution, in social factors, and in population structure are so rapid that our hopes of getting a simple answer are somewhat dimmed. But we do hope that though we may never know what did the damage, we may as a result of enlightened technology see the steady diminution of the appalling suffering which we suspect to be the result of our fouling of the air.

In the meantime, we must think clearly and prosecute our campaigns for clean air on firm scientific bases, remembering Huxley’s warning that “irrationally held truths may be more harmful than reasoned errors.”